5.15 PUBLIC HEALTH

This section presents the methodology and results of a human health risk assessment performed to assess potential impacts and public exposure associated with airborne emissions from both construction and operation of the Palomar Energy Project. Impacts on air quality from criteria pollutant emissions were addressed in Section 5.2, and thus this section addresses only air toxics.

Also of concern with respect to public health are potential risks due to hazardous materials onsite and potential exposures to electromagnetic fields. Risks associated with hazardous materials handling are addressed in Section 5.12. Since the Palomar project will utilize existing transmission facilities and no new transmission lines will be constructed, a discussion of electromagnetic field exposure is not relevant.

Small quantities of hazardous waste may be generated during the construction and operational phases of the project. Hazardous waste management plans will be in place, and the potential for public exposure is considered minimal (see Section 5.13, Waste Management). Programs to achieve a safe workplace for Palomar employees are described in Section 5.14, Worker Safety.

5.15.1 Affected Environment

For the purposes of the air quality and public health risk assessments, the Palomar project turbine stacks will exhaust combustion gases at 110 feet (33.5 meters) above the facility base elevation. Topographical features within a 10-mile radius of equal or greater elevation than the stack exhaust exit point (i.e., stack height above facility base elevation 860 feet or 262 meters) are shown in Figure 5.15-1. Rather than provide this map on a 1:24,000 scale, the scale of the map has been adjusted to more easily display the information (as has been approved for other AFCs).

Sensitive receptors are defined as groups of individuals that may be more susceptible to health risks due to chemical exposure. Schools (public and private), day care facilities, convalescent homes, and hospitals are of particular concern. For consistency with Section 5.12 (Hazardous Materials Handling), parks, and emergency response facilities including fire and police stations were also included as sensitive receptors. The modeled sensitive receptors are shown in Figure 5.12-1.

Figure 5.15-1 Terrain Above Stack Height within a 10-mile Radius of the Proposed Plant Site

5.15.2 Environmental Impact

The methods used to assess potential human health risks are consistent with those presented in the document prepared by the California Air Pollution Control Officers' Association (CAPCOA) Air Toxics "Hot Spots" Program: Revised 1992 Risk Assessment Guidelines (CAPCOA, 1993). CAPCOA guidelines were developed to provide risk assessment procedures for use in the preparation of health risk assessments required under the Air Toxics "Hot Spots" Information and Assessment Act of 1987, AB 2588 (Health and Safety Code Section 44360 et seq.). The "Hot Spots" law established a statewide program for the inventory of air toxics emissions from individual facilities, as well as requirements for risk assessment and public notification of potential health risks.

The following sections provide a health risk assessment of Palomar project operations. An analysis also is provided to determine risks from particulate matter emitted during Palomar project construction.

5.15.2.1 Risk Definitions and Significance

Cancer Risk. Cancer risk is the probability or chance of contracting cancer over a human life span (assumed to be 70 years). Carcinogens are not assumed to have a threshold below which there would be no human health impact. In other words, any exposure to a carcinogen is assumed to have some probability of causing cancer; the lower the exposure, the lower the cancer risk (i.e., a linear, no-threshold model). Under various state and local regulations, an incremental cancer risk of 10-in-one-million due to a project is considered to be a significant impact on public health. For example, the 10-in-one-million risk level is used by the Air Toxics "Hot Spots" (AB2588) program and California's Proposition 65 as the public notification level for air toxic emissions from existing sources. The SDAPCD Rule 1200(d)(i) allows for an incremental risk of 10-in-one-million in permitting new sources, provided toxics best available control technology (T-BACT) is employed, which for combustion sources, is generally considered to be firing natural gas. For assessing the significance of potential risks from Palomar project emissions, the significant impact criteria for lifetime incremental cancer risk of 10-in-one-million is appropriate.

Non-Cancer Risk. Non-cancer health effects can be either chronic or acute. In determining potential non-cancer health risks (chronic and acute) from air toxics, it is assumed that there is a dose of the chemical of concern below which there would be no impact on human health. The air concentration corresponding to this dose is called the reference exposure level (REL). Non-cancer health risks are measured in terms of a hazard index, which is the calculated exposure of each contaminant divided by its REL. Hazard indices for those pollutants affecting the same target organ are typically summed, with the resulting totals expressed as hazard indices for each organ system. A hazard index of less than 1.0 is considered to be an insignificant health risk (SDAPCD Rule 1200(d)(2) and (d)(3)). For this health risk assessment, all hazard indices were summed regardless of target organ. This method leads to a conservative (upper bound) assessment. RELs used in the hazard index calculations were those published in the CAPCOA AB2588 Risk Assessment Guidelines (CAPCOA, 1993), as updated in September 2001 by the California Office of Environmental Health Hazard Assessment (OEHHA) in the *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* (OEHHA, 2001).

Chronic toxicity is defined as adverse health effects from prolonged chemical exposure, caused by chemicals accumulating in the body. Because chemical accumulation to toxic levels typically occurs slowly, symptoms of chronic effects usually do not appear until long after exposure commences. The lowest no-effect chronic exposure level for a noncarcinogenic air toxic is the chronic REL. Below this threshold, the body is capable of eliminating or detoxifying the chemical rapidly enough to prevent its accumulation. The chronic hazard index was calculated using the hazard indices calculated with model-predicted annual concentrations.

Acute toxicity is defined as adverse health effects caused by a short-term chemical exposure of no more than 24-hours. For most chemicals, the multi-pathway exposure required to produce acute effects is higher than levels required to produce chronic effects because the duration of exposure is shorter. Because acute toxicity is predominantly manifested in the upper respiratory system at threshold exposures, all hazard indices are typically summed to calculate the total acute hazard index. Model-predicted one-hour average concentrations are divided by acute RELs to obtain a hazard index for health effects caused by relatively high, short-term exposure to air toxics.

Diesel Particulate Risk. In 1990, the State of California administratively listed under Proposition 65 the particulates formed in the exhaust of diesel powered equipment as a chemical known to the State to cause cancer. For estimating risks due to diesel particulate matter exhaust, the risk assessment methodology used was consistent with that employed by the California Air Resources Board (ARB) in the document entitled "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" (ARB, 2000).

OEHHA has estimated that 130 to 2,400 "excess" cancer cases would be expected to occur in a population of 1 million people breathing an average concentration of diesel exhaust particles of 1 $\mu g/m^3$ over a 70-year lifetime. These excess cancer cases are beyond what would be expected to occur if there were no diesel exhaust particles in the air. An independent review by the ARB Scientific Review Panel (SRP) derived a "best-estimate" of the cancer unit risk factor as 300 excess cancer cases per million people breathing 1 $\mu g/m^3$ of diesel particles over a lifetime (OEHHA, 2000).

5.15.1.2 Health Risk Assessment Approach

The health risk assessment was conducted in three steps. First, emissions of toxic air contaminants from the project were estimated. Second, exposure calculations were performed using proposed and approved EPA dispersion models. Third, results of the exposure calculations along with the respective cancer health risk factors, and chronic and acute non-cancer reference exposure levels for each toxic substance were used to perform the risk characterization to quantify individual health risks associated with predicted levels of exposure.

For the health risk assessment, air contaminant inhalation and plant ingestion are the dominant pathways for public exposure to chemical substances released by the Palomar facility. Emissions will consist primarily of combustion by-products produced in the natural gas fired turbines and duct burners with secondary emissions of metals as dissolved solids in cooling tower drifts accounting for a much smaller portion of the projected risk. The inhalation pathway is expected to represent the majority of the predicted risk.

However, since a portion of the toxics potentially emitted by the Palomar facility are considered multi-pathway air toxics, a multi-pathway risk analysis was performed. The multi-pathway analysis evaluated the following routes of exposure: inhalation, soil ingestion, dermal absorption, mother's milk ingestion, and plant product ingestion.

Emissions Characterization

Palomar project construction and operations were evaluated to determine if there are particular substances that will be used or generated that may cause adverse health effects if released to the air. The chemicals evaluated in this analysis were identified from the CAPCOA guidelines (CAPCOA, 1993) and from the OEHHA *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* (OEHHA, 2001). The primary sources of emissions during operation are the natural-gas-fired combustion turbine generators (CTGs) and duct burners, and the aqueous ammonia slip stream (ammonia slip) from the selective catalytic reduction (SCR) control system located in the heat recovery steam generators (HRSGs). Table 5.15-1 presents a list of substances that potentially may be emitted from the turbines and duct burners. These toxic air contaminant species were identified in the California Air Toxics Emission Factor (CATEF) database, as updated in January 2001 (ARB, 2001).

Air toxic emissions are potentially emitted from the cooling tower, as summarized in Table 5.15-2. Potential emissions from the cooling tower were identified based on an effluent water quality analysis of reclaimed water from the City of Escondido's Hale Avenue Resource Recovery Facility (HARRF), which is proposed for use in the Palomar project cooling tower.

Table 5.15-1 List of Toxic Air Contaminants Potentially Emitted from Natural Gas-Fired Turbines

	Carcinogen		Non-carcinogen	
	Inhalation	Multi-Pathway	Chronic	Acute

Table 5.15-1 List of Toxic Air Contaminants Potentially Emitted from Natural Gas-Fired Turbines

	Carcinogen		Non-carcinogen	
	Inhalation	Multi-Pathway	Chronic	Acute
Acetaldehyde	X		X	
Acrolein			X	X
Ammonia[1]			X	X
Benzene	X		X	X
1,3—Butadiene	X			
Ethylbenzene			X	
Formaldehyde	X		X	X
n-Hexane			X	
Naphthalene			X	
Propylene			X	
Propylene Oxide	X		X	X
Toluene			X	X
Xylene			X	X
Composite PAHs[2]	X	X		
Speciated PAHs[3]				
Benzo(a)anthracene	X	X		
Benzo(a)pyrene	X	X		
Benzo(b)fluoranthene	X	X		
Benzo(k)fluoranthene	X	X		
Chrysene	X	X		
Indeno(1,2,3-cd)pyrene	X	X		

Notes:

1. Ammonia is not a product of combustion, but is emitted due to excess ammonia in the SCR control system.
2. Composite PAHs: Unspeciated polycyclic aromatic hydrocarbons; risk value assumed for benzo(a)pyrene.
3. Speciated PAHs: Speciated polycyclic aromatic hydrocarbons for which emission factors are available from the CATEF database.

Table 5.15-2 List of Toxic Air Contaminants Potentially Emitted as Dissolved Solids in Cooling Tower Drift

	Carcinogen		Non-carcinogen	
	Inhalation	**Multi-Pathway**	**Chronic**	**Acute**
Arsenic	X	X	X	X
Antimony			X	
Beryllium	X		X	
Cadmium	X		X	
Copper			X	X
Lead	X	X		
Manganese			X	
Mercury			X	X
Nickel	X		X	X
Vanadium				X
Zinc			X	

Emissions posing potential health risks to the surrounding community during power plant construction consist primarily of the exhaust from diesel powered equipment.

Emissions of toxic air contaminants associated with the combustion of natural gas were calculated using emission factors from the CATEF database available from the California Air Resources Board (http://www.arb.ca.gov/emisinv/catef/catef.htm). The appropriate combustion emission factors, excluding Polycyclic Aromatic Hydrocarbons (PAHs), utilized in the modeling are presented in Table 5.15-3. Emission factors for PAHs are provided in Table 5.15-4. The emission factors for the turbines were based on the available factors in CATEF for natural gas-fired turbines. For simplicity, the emission factors for the turbines were also applied to the duct burners. This assumption results in an over estimate of the emissions, since the turbine factors are higher than the emission factors for the duct burners available in CATEF. Except for ammonia and consistent with the Otay Mesa project, it was assumed that 50 percent of the toxic air emissions from the turbines and duct burners will be controlled by the oxidation catalyst control system. Ammonia slip from the SCR control system was calculated based on an emissions limit of 10 ppmvd (at 15 percent O_2) per turbine.

Table 5.15-3 Toxic Air Contaminant Emission Factors and Emissions, Excluding PAHs (Natural Gas-Fired Turbines and Duct Burners with SCR and Oxidation Catalyst)

	CATEF Emission Factor [1] (lb/MMscf)	Maximum Hourly Emissions Per Turbine[2] (lb/hr)	Annual Emissions Per Turbine[3] (ton/yr)
Acetaldehyde	1.37E-01	1.31E-01	5.41E-01
Acrolein	1.89E-02	1.81E-02	7.47E-02
Ammonia [4]	---	2.75E+01	1.13E+02
Benzene	1.33E-02	1.28E-02	5.26E-02
1,3—Butadiene	1.27E-04	1.22E-04	5.02E-04
Ethylbenzene	1.79E-02	1.72E-02	7.07E-02
Formaldehyde	9.17E-01	8.80E-01	3.62E+00
n-Hexane	2.59E-01	2.49E-01	1.02E+00
Naphthalene	1.66E-03	1.59E-03	6.56E-03
Propylene	7.71E-01	7.40E-01	3.05E+00
Propylene Oxide	4.78E-02	4.59E-02	1.89E-01
Toluene	7.10E-02	6.81E-02	2.81E-01
Xylene	2.61E-02	2.50E-02	1.03E-01

Notes:
1. California Air Toxics Emission Factor (CATEF) database (2001).
2. Maximum hourly emissions based on a combined maximum natural gas consumption rate of 1.92 MMscf per hour per turbine and duct burner pair and an assumed 50% control on toxics through the use of an oxidation catalyst.
3. Based on a combined annual average natural gas consumption rate of 1.81 MMscf per hour per turbine and duct burner pair and an assumed 50% control on toxics through the use of an oxidation catalyst.
4. Based on maximum ammonia slip (10 ppmvd) from the SCR control device.

Table 5.15-4 Toxic Air Contaminant Emission Factors and Emissions for PAHs (Natural Gas-Fired Turbines and Duct Burners with SCR and Oxidation Catalyst)

	CATEF Emission Factor [1] (lb/MMscf)	Maximum Hourly Emissions Per Unit[2] (lb/hr)	Annual Emissions Per Unit[3] (ton/yr)
Acenaphthene	1.90E-05	1.82E-05	7.51E-05
Acenaphthylene	1.47E-05	1.41E-05	5.81E-05
Anthracene	3.38E-05	3.24E-05	1.34E-04
Benzo(a)anthracene [4]	2.26E-05	2.17E-05	8.93E-05
Benzo(a)pyrene [4]	1.39E-05	1.33E-05	5.49E-05
Benzo(b)fluoranthene [4]	1.13E-05	1.08E-05	4.46E-05
Benzo(e)pyrene	5.44E-07	5.22E-07	2.15E-06
Benzo(g,h,i)perylene	1.37E-05	1.31E-05	5.41E-05
Benzo(k)fluoranthene [4]	1.10E-05	1.05E-05	4.35E-05
Chrysene [4]	2.52E-05	2.42E-05	9.96E-05
Dibenz(a,h)anthracene	2.35E-05	2.25E-05	9.29E-05
Fluoranthene	4.32E-05	4.14E-05	1.74E-04
Fluorene	5.80E-05	5.57E-05	2.29E-04
Indeno(1,2,3-cd)pyrene [4]	2.35E-05	2.25E-05	9.29E-05
Phenanthrene	3.13E-04	3.00E-04	1.24E-03
Pyrene	2.77E-05	2.66E-05	1.09E-04
Composite PAHs [5]	---	5.25E-04	2.16E-03

Notes:
1. California Air Toxics Emission Factor (CATEF) database (2001).
2. Maximum hourly emissions based on a combined maximum natural gas consumption rate of 1.92 MMscf per hour per turbine and duct burner pair and an assumed 50% control on toxics through the use of an oxidation catalyst.
3. Based on a combined annual average natural gas consumption rate of 1.81 MMscf per hour per turbine and duct burner pair and an assumed 50% control on toxics through the use of an oxidation catalyst.
4. PAHs for which there is a unit risk factor quantified by OEHHA (2001).
5. Composite PAH emissions are the sum of all PAHs less the OEHHA (2001) PAHs with unit risk factors.

For annual emissions, the annual average natural gas consumption rate of 1.63 MMscf per hour per turbine plus 0.18 MMscf per hour per duct burner (1.81 MMscf per hour combined) was used, assuming that the turbines will operate continuously (i.e., 8,760 hours per year). For hourly emissions, the maximum natural gas consumption rate of 1.73 MMscf per hour per turbine plus 0.19 MMscf per hour per duct burner (1.92 MMscf per hour combined) was used.

Concentrations of toxics present in the cooling tower make-up water were obtained from an effluent water quality analyses from the City of Escondido's HARRF, which will provide reclaimed water for the Palomar project. Emission rates were calculated from the effluent analysis, re-circulation rate, drift control efficiency, total dissolved solids concentration (TDS), and the fraction of TDS assumed to be PM_{10}. Emission rates for the cooling tower are summarized in Table 5.15-5, which also provides details of the emission calculations in the table footnotes. Hourly and annual emissions rates for the turbines and duct burners, and cooling tower were converted to a modeled emission rate in grams per second (g/s) for use in the risk modeling.

It is estimated that diesel particulate matter will be emitted during construction activities from construction equipment at an average hourly emission rate of 0.31 lb/hr. The modeled emission rate was calculated as an effective annual average emission rate over the entire 21-month construction period. Details of the construction emissions are provided in Appendix E.2.

Table 5.15-5 Toxic Air Contaminant Emission Rates for Cooling Tower

Contaminants[1]	Average Reported Concentration (mg/l) [2]	Maximum Concentration (mg/l) [3]	Maximum Hourly Emissions (lb/hr) [4]	Annual Emissions (ton/yr) [5]
Arsenic	0.0011	0.0045	1.46E-06	6.41E-06
Antimony	0.0004	0.0018	5.98E-07	2.62E-06
Beryllium[1]	0.000004	0.00002	5.35E-09	2.30E-08
Cadmium	0.0001	0.0005	1.56E-07	6.84E-07
Copper	0.0071	0.0290	9.44E-06	4.14E-05
Lead	0.0018	0.0072	2.34E-06	1.03E-05
Manganese	0.2339	0.9615	3.13E-04	1.37E-03
Mercury[1]	0.0001	0.0004	1.34E-07	5.87E-07
Nickel	0.0098	0.0403	1.31E-05	5.74E-05
Vanadium	0.0022	0.0092	3.00E-06	1.31E-05
Zinc	0.0701	0.2881	9.38E-05	4.11E-04

1. Metal concentrations from Escondido HARRF Secondary Effluent Analysis with a detectable concentration during the analysis period. Beryllium and mercury were also analyzed but not detected, and thus assumed to be ½ the detection limit.
2. Average seasonal effluent concentrations during the period from winter 1995 through fall 2000.
3. Maximum concentrations calculated by extrapolating the average reported metal concentrations by the total dissolved solids (TDS) from seasonal effluent analyses (972.9 mg/l) to the maximum TDS value for the cooling tower (4,000 mg/l).
4. Maximum lb/hr emission rates calculated by multiplying total re-circulation rate (130,000 gal/min) by the drift fraction (0.0005%) and maximum metal concentrations, and converting to lb/hr.
5. Annual emission rates calculated from maximum lb/hr emission rates assuming 8,760 hr/yr.

Risk Assessment Dispersion Modeling Methodology

Once the emissions and source parameters were identified, the exposure assessment portion of the health risk assessment for routine operations was conducted, using the most recent versions of the ISCST3 and AERMOD dispersion models (see modeling protocol in Appendix E). These models formed the basis of the dispersion assessment, as required by the current California AB2588 guidelines. The ISCST3 and AERMOD models were run using the same regulatory default values and meteorology data as used for in the air quality modeling analysis (Section 5.2.3.2).

To identify the sites of maximum impact due to power plant operation, Cartesian receptor grids were developed for the receptor domains defined in the modeling protocol. All turbine scenarios were analyzed using a unit emission rate (i.e., 1 g/s) to determine the worst-case stack parameters for both the acute (1-hour) and chronic (annual) averaging periods. Two receptor domains were identified to contain the highest predicted impacts: 1) For nearfield impacts at or below stack height, the simple terrain (MainISC) receptor domain was predicted to contain the maximum impacts using the ISCST3 model, which included the facility fenceline, and 2) for all elevated terrain impacts above stack height, including the elevated terrain receptors above stack heights in the MainISC domain, the West Hills receptor domain was predicted to contain the maximum impacts using the AERMOD model.

In addition to these receptor grids, discrete sensitive receptors were defined as groups of individuals that may be more susceptible to health risks due to chemical exposure. Schools (public and private), day care facilities, convalescent homes, and hospitals are of particular concern.

A list of sensitive receptors within approximately 2.5 miles (4.0 km) of the facility are provided in Table 5.15-6 and shown in Figure 5.12-1. Since the sensitive receptors are located in the MainISC receptor domain, and are below stack height, the ISCST3 model was used. Sensitive receptors were identified using the 2000 Thomas Guide and 2001 local phone book; sensitive receptor elevations were obtained from the USGS Escondido 7.5-minute quadrangle topographic map.

The ISCST3 and AERMOD models were executed using a unit emission rate (1 g/s) for each respective receptor domain and worst-case turbine scenario. Results of the dispersion modeling were then used to estimate the predicted chronic adverse health effects (both carcinogenic and non-carcinogenic) and acute adverse health effects.

Risk Characterization

Carcinogenic risks (defined as a 70-year, residential exposure) and potential chronic and acute non-cancer health effects were assessed using the dispersion modeling described above and numerical values of toxicity provided in the OEHHA *Consolidated Health Risk Value* tables (OEHHA, 2001) and the CAPCOA Guidelines (1993). The environmental pathways that

Table 5.15-6 Sensitive Receptors

Receptor No. [1]	Description	Approximate Distance from Site (km)	Direction from Site
1	Fire Station	3.3	Northwest
2	School	2.4	North-northwest
3	Park	2.3	North-northwest
4	Fire Station	2.8	East-northeast
5	Park	3.4	East-northeast
6	Palomar Medical Center	4.3	East-northeast
7	Central School	3.6	East
8	Park	2.7	East-southeast
9	San Diego County Child Development Center	3.1	East-southeast
10	Felicita School	3.6	East-southeast
11	Hospice	3.7	East-southeast
12	School	3.7	East-southeast
13	Del Dios Middle School	2.1	Southeast
14	Escondido Adventist Academy	2.1	Southeast
15	Little Country Preschool	1.8	South-southeast
16	Undeveloped Park	1.7	South
17	School	4.4	Southeast
18	Felicita Adult Care	4.2	Southeast

Notes:

1 Receptors are depicted in Figure 5.12-1

were analyzed consist of all pathways recommended in the CAPCOA Guidelines (1993) for a screening-level health risk assessment.

The risk characterization portion of the assessment utilized the Assessment of Chemical Exposure for AB 2588 (ACE2588) model following the CAPCOA AB 2588 risk assessment guidelines. The ACE2588 model was executed using the maximum 1-hour and annual toxic emission rates, along with the OEHHA health risk values, to determine the predicted health risks due to exposure to the toxic substances potentially emitted from the turbines, duct burners, and cooling tower.

The cancer risk for an inhaled air toxic is estimated by multiplying the exposure concentration [in micrograms per cubic meter, ($\mu g/m^3$)] by its "unit risk factor", which is the estimated cancer risk for a continuous exposure to 1 $\mu g/m^3$ of the substance over a specified averaging time. The averaging time for the cancer risk estimate is usually 70 years, which is used to represent a lifetime exposure. For the cancer risk assessment, the results of the exposure assessment dispersion modeling along with annual emission rates from the turbines and duct burners, and cooling tower were multiplied by the respective unit risk factor for each toxic. This approach yields a direct result in terms of inhalation cancer risk for all emitted toxic pollutants.

The multi-pathway cancer risk analysis followed CAPCOA guidance (1993), and included the inhalation, dermal absorption, soil, water, plant, and animal ingestion, as well as mother's milk pathways.

For chronic, non-cancer health risk, the results of the exposure assessment dispersion modeling, along with annual emission rates, were divided by the chronic reference exposure level (REL) for each compound. Similarly the results of the exposure assessment along with maximum lb/hr emission rates were divided by the acute reference exposure level (REL) for each compound. Thus, model outputs were in terms of chronic hazard index and acute hazard index, respectively. The cancer unit risk factors and the chronic and acute RELs were obtained from the OEHHA (2001) and were included as input to the ACE2588 model. Unit risk factors and reference exposure levels are listed in Table 5.15-7.

The chief exposure assumption is one of continuous exposure (at maximum emission rates) over a 70-year period at each identified receptor location. When combined with proposed and approved EPA dispersion modeling methodologies, the use of the CAPCOA methods (ACE2588 model) provide an upper bound estimate of the true risks. That is, the actual risks are not expected to be any higher than the predicted risks and are likely to be substantially lower. A discussion of uncertainty factors is presented in Section 5.15.2.4.

Construction activity emissions are planned to occur over a period of 21 months. To estimate a potential 70-year residential exposure to diesel particulate matter emitted during construction, the modeled annual concentrations must be multiplied by the value 0.025, which

Table 5.15-7 Unit Risk Factors and Reference Exposure Levels

Pollutant	Cancer Risk		Acute Reference Exposure Level (μg/m³)	Chronic Reference Exposure Level (μg/m³)
	Unit Risk Factor $(\mu g/m^3)^{-1}$	Oral Dose (mg/kg-day)		
Acetaldehyde	2.7E-06	---	---	9.0E+00
Acrolein	---	---	1.9E-01	6.0E-02
Ammonia	---	---	3.2E+03	2.0E+02
Benzene	2.9E-05	---	1.3E+03	6.0E+01
1,3—Butadiene	1.7E-04	---	---	2.0E+01
Ethylbenzene	---	---	---	2.0E+03
Formaldehyde	6.0E-06	---	9.4E+01	3.0E+00
n-Hexane	---	---	---	7.0E+03
Naphthalene	---	---	---	9.0E+00
Propylene	---	---	---	3.0E+03
Propylene Oxide	3.7E-06	---	3.1E+03	3.0E+01
Toluene	---	---	3.7E+04	3.0E+02
Xylene	---	---	2.2E+04	7.0E+02
Benzo(a)anthracene [1]	1.1E-04	1.2E+00	---	---
Benzo(a)pyrene [1]	1.1E-03	1.2E+01	---	---
Benzo(b)fluoranthene [1]	1.1E-04	1.2E+00	---	---
Benzo(k)fluoranthene [1]	1.1E-04	1.2E+00	---	---
Chrysene [1]	1.1E-05	1.2E-01	---	---
Indeno(1,2,3-cd)pyrene [1]	1.1E-04	1.2E+00	---	---
Composite PAHs [2]	1.1E-03	1.2E+01	---	---
Arsenic	3.3E-03	1.5E+00	1.9E-01	3.0E-02
Antimony	---	---	---	2.0E-01
Beryllium	2.4E-03	---	---	4.8E-03
Cadmium	4.2E-03	---	---	2.0E-02
Copper	---	---	1.0E+02	2.4E+00
Lead	1.2E-05	8.5E-3	---	---
Manganese	---	---	---	2.0E-01
Mercury	---	---	1.8E+00	9.0E-02
Nickel	2.6E-04	---	6.0E+00	5.0E-02
Vanadium	---	---	3.0E+01	---
Zinc	---	---	---	3.5E+01
Diesel Exhaust Particulate	3.0E-04	---	---	5.0E+00

Notes:

1 Speciated PAHs for which OEHHA (2001) has defined risk values.

2 Composite PAH risk values assumed to be equivalent to benzo(a)pyrene.

is 21 months divided by 840 (12 months times 70 years). Multiplication of the modeled annual diesel exhaust concentration by this factor results in an estimate of an average 70-year exposure resulting from a 21-month construction period. Because the modeling methodology accounts for the time of day of the emissions, there is no separate adjustment required for estimation of the 70-year maximum residential and maximum offsite worker exposure.

For the construction modeling, a single area source was used to model construction activities. The property line was assumed to be the boundary of the Palomar project (Planning Area 1 of the ERTC industrial park). For assessing potential offsite risks at residential receptors due to construction activities, receptors were placed at 100-foot spacing adjacent and west of ERTC industrial park Planning Areas 4 and 5. Discrete receptors were also placed at residences between PA 9 and PA 10 of the ERTC industrial park. Potential maximum exposures for workers at nearby businesses were estimated using property line receptors and receptors at selected offsite building locations.

Once the adjusted 70-year exposure value was obtained for the construction activities, the potential cancer risk posed by diesel particulate matter emissions was estimated as the 70-year exposure times the unit risk factor established by ARB for diesel particulate matter of 300 per million per $\mu g/m^3$.

5.15.1.3 Risk Assessment Results

Project Operation. The exposure assessment portion of the analysis was performed for the worst-case simple terrain receptor domain (with ISCST3) and elevated terrain receptor domains (with AERMOD). Maximum 1-hour and annual impacts due to facility normal operations occur in the nearby elevated terrain. Sensitive receptors also were included in the analysis.

Table 5.15-8 presents the estimated lifetime cancer risks (i.e., the 70-year residential excess cancer risk) for project operation at the maximum impact points attributable to all carcinogenic contaminants within each receptor domain. For assessing cancer health risks, calculated exposures were based on annual-average emission rates and dispersion modeling results. The maximum incremental lifetime cancer risk was calculated to be approximately 0.92-in-one-million within the West Hills receptor domain at approximately 2 miles (3.2 kilometers west-southwest of the Palomar project site. This calculated risk is below the ARB and SDAPCD significance criterion of 10-in-one-million. Estimated cancer risks at sensitive receptors in the project area were very low, with the peak sensitive receptor cancer risk of 0.1-in-one-million, which is one percent of the significance threshold. Thus, the project poses an insignificant cancer risk according to established regulatory guidelines.

Table 5.15-8 also presents the calculated chronic non-cancer hazard index at the maximum impact location attributable to each contaminant from the modeled sources during normal operation. For assessing chronic non-cancer health effects, calculated exposures were based on annual-average emission rates and annual dispersion modeling results. The total chronic hazard index of 0.05 was predicted to occur in the West Hills domain approximately 2 miles (3.2 kilometers) west-southwest of the Palomar project site. The maximum sensitive receptor non-cancer chronic hazard index is predicted to be 0.01. This is one percent of the 1.0 hazard index that is considered the threshold of significant impact.

Table 5.15-8 Air Toxic Study Results for Normal Operations

Receptor Domain	Cancer Risk at Maximum Point of Impact[1] (per million)	Acute Hazard Index at Maximum Point of Impact	Chronic Hazard Index at Maximum Point of Impact
MainISC (Simple Terrain)	0.15	0.30	0.01
West Hills (Elevated)	0.92	0.27	0.05

Note:

[1] 70-year residential excess cancer risk.

Table 5.15-8 also presents the calculated acute hazard index at the maximum impact location due to acute exposure for all contaminants. Acute exposures were based on maximum 1-hour emission rates and predicted 1-hour average concentrations. The maximum acute hazard index was calculated to be 0.30 at the western fenceline of the Palomar facility. The maximum sensitive receptor acute hazard index is predicted to be 0.04, which is well below the threshold of significance.

Predicted chronic and acute non-cancer health effects at all receptors are below the significance criteria of 1.0. Therefore, the project should have insignificant non-cancer health effects based on regulatory guidelines.

Project Construction. The estimated 70-year exposure residential cancer risk posed by diesel emissions from Palomar project construction at the location of the maximum exposed individual resident (MEIR) is 0.33 per million. The estimated 70-year cancer risk for the maximum exposed individual worker (MEIW) in the nearest commercial building to the project site is 3.9 per million. At the project property line, the point of maximum impact (PMI) cancer risk is 8.6 per million. The maximum risk at the MEIR, MEIW, and PMI are all below the ARB and SDAPCD significance level of 10 per million.

Modeling results indicate that the estimated annual concentration of diesel particulate matter due to construction activities at a residential receptor is 0.044 $\mu g/m^3$. The resulting hazard index (HI), based on a chronic reference exposure level of 5.0 $\mu g/m^3$, is 0.01. The estimated annual concentration of diesel particulate at the location of the nearest commercial building to the Palomar site is 0.52 µg/m^3, resulting in a hazard index of 0.1. At the project property line, the point of maximum impact annual diesel particulate concentration is 1.2 µg/m^3, resulting in a hazard index of 0.2. The maximum chronic hazard index at the MEIR, MEIW, and PMI are all well below the ARB and SDAPCD significance level of 1.0.

5.15.1.4 Uncertainties in the Analysis

Sources of uncertainty in the assessment of risks to public health include emissions estimates, dispersion modeling, exposure characteristics, and extrapolation of toxicity data in animals to humans. To address this uncertainty, highly conservative assumptions were used in this risk assessment, as discussed below.

Emissions. There are inherent uncertainties in the emission factor estimates used for gas turbines and duct burners obtained from CATEF. However, for both the 1-hour and annual averaging periods, it was assumed that both gas turbines and duct burners operate at the maximum heat input rate. The annual averaging period emission estimates are based on a maximum operation of 8,760 hours per year. Under actual operations, the hours of operation and typical heat input rates will be lower. Therefore, the emission estimates have uncertainties, but are used in a manner that tend to over-estimate emissions.

Air Dispersion Modeling. In general, EPA-approved dispersion models such as ISCST3 tend to over-predict concentrations rather than under-predict. Although AERMOD is an improvement, its intention is to provide conservative concentration estimates (Proposed Rule, *Guideline on Air Quality Models*, FR21506 April 21, 2000). For example, the model algorithms assume chemical emissions are not transformed in the atmosphere into other chemical compounds. For certain pollutants, conversion may occur quickly enough to reduce concentrations from the conservative model predictions.

Exposure Assessment. The most important uncertainties related to exposure include the definitions of exposed populations and their exposure characteristics. The choice of a "residential" maximally exposed individual is very conservative in the sense that no real person is likely to spend 24 hours a day, 365 days a year over a 70-year period at exactly the point of highest toxicity-weighted annual average air concentration at the selected residential location.

Toxicity Assessment. Another area of uncertainty is in the use of toxicity data in risk estimation. Estimates of toxicity for the health risk assessment were obtained from the CAPCOA AB 2588 Guidelines (CAPCOA 1993), which is among the most conservative compilations of toxicity information. Toxicity estimates are derived either from observations in humans or from projections derived from experiments with laboratory animals. When toxicity estimates are derived from animal data, they usually involve extra safety factors to account for possibly greater sensitivity in humans, and the less-than-human-lifetime observations in animals. Overall, the toxicity assumptions and criteria used in the proposed project risk assessment are biased toward over-estimating risk. The amount of the bias is unknown, but could be substantial.

Diesel Particulate Unit Risk Factor. The diesel exhaust unit risk factor is a "best-estimate" value established by the ARB Scientific Review Panel (SRP) based on review of more than 30 diesel exposure studies. The established unit risk factor is a 95th percentile upper confidence limit value, implying that there is only a 5% chance that the value is underestimated (too low). In addition, the most significant of the studies reviewed by the SRP are occupational studies of exposure of diesel exhaust by railroad workers. The occupational results were then extrapolated to the general population, which includes more sensitive individuals than healthy railroad workers.

Duration of Exposure during Construction. The assessment of cancer risk is based on an assumed continuous 70-year exposure. However, the construction of the proposed project will take only 21 months. While the peak construction impacts are reduced to account for the 21-month activity duration versus 70-year risk assessment period, no adjustment is made to account for the lack of a continuous exposure for the duration of the 70-year assessment period. Therefore, it is likely that the modeled annual concentration is a significant overestimate of the potential exposure to diesel exhaust that will occur as a result of the construction of the Palomar project.

5.15.3 Mitigation Measures

The Palomar project has been designed to minimize potential public health risks, including the use of natural gas as fuel for the turbines and duct burners, and incorporation of appropriate emission control measures. Based on the results of the toxic air contaminant risk assessment for normal operations, no additional mitigation measures are required to reduce risks due to normal operations. All risk estimates are within acceptable levels.

To mitigate potential risks during Palomar project construction due to diesel exhaust, catalyzed diesel particulate filters will be installed on suitable construction equipment. To be considered suitable, the equipment must be large (>50 hp), generally operate at consistent loads, and be continually onsite for long durations (>3 months).

5.15.4 Significant Unavoidable Adverse Impact

No significant unavoidable adverse impacts on public health are anticipated from the proposed project.

5.15.5 Cumulative Impacts

The projects included in the cumulative assessment are the CalPeak and RAMCO power plants, both small (<50 MW) gas turbine power plants located near the proposed project site. The CalPeak site is adjacent to the northern boundary of the Palomar site; the RAMCO site is 0.5 mile northwest of the Palomar site.

As discussed in Section 5.2.3.6, the CalPeak and RAMCO facilities will contribute a very small incremental impact to the area of maximum impact of the Palomar project. Since these two facilities also burn natural gas, they would emit similar air toxics, but in much smaller quantities due to their relatively small size. Therefore, no significant cumulative health risk to the public is expected from these facilities.

The balance of this section addresses the potential cumulative construction and operation impacts related to the ERTC industrial park together with the Palomar project. This analysis is based on currently available information and the application of assumptions and methodologies developed for this AFC. Public health impacts of the ERTC industrial park will be further evaluated as direct impacts of that project in the City of Escondido's EIR, which is currently in preparation.

Overall ERTC Industrial Park Construction

Overall construction of the ERTC industrial park will occur over a several year period from 2002 to 2008. It will include an initial site preparation phase that will last about eight months, and involve considerable earthmoving to prepare building pads in each of eight planning areas (including Planning Area 1, the Palomar site), and to develop roadways and other infrastructure. Subsequent phases of ERTC industrial park construction will involve the development primarily of one and two-story concrete tilt-up industrial buildings and low-rise office buildings in the various industrial park planning areas. The cumulative diesel particulate emissions for industrial park grading and Palomar project construction are presented in Appendix E.6.

The City of Escondido's EIR for the ERTC industrial park will address air quality and related public health issues. Public health impacts of construction phase earthwork at the Palomar project site, PA 1 of the ERTC industrial park, are addressed below.

Planning Area 1 Construction Phase Earthwork

CEC staff adequacy reviews of the Public Health sections of recent AFCs have requested presentation of the potential risks due to diesel particulate emissions from construction activities. Such an analysis was presented in Section 5.15.2.3 concerning Palomar project construction emissions.

In order to provide information requested by CEC staff, the following section presents a similar analysis for grading activities for PA 1. Construction of the ERTC industrial park will include removal of earthen material from PA 1 and transportation of the material to PAs 2 through 8. The PA 1 grading activities will be conducted in two phases. The first phase of grading will consist of the removal and transport of overburden (soil) from PA 1 to the other ERTC industrial park planning area within the ERTC industrial park, which is expected to last approximately 10 working days. The second phase of grading will consist of the removal of rock and additional soil from PA 1 to the other ERTC industrial park planning areas and is expected to last approximately 60 working days. Total diesel particulate emissions from equipment associated with PA 1 grading for the two phases of grading are estimated at 45 and 29 lb/day, respectively (detailed emission assumptions and calculations are provided in Appendix E.6). This site preparation work will be performed prior to Palomar project construction activities.

Diesel particulate emissions during grading activities associated with PA 1 were modeled as multiple area sources, each with a uniform emissions density based on estimated activity in the planning area. Grading activities were modeled using the same hourly emission factors as the power plant construction modeling. The ERTC industrial park property line was utilized to assess offsite worker exposure for PA 1 grading activities. For additional perspective, potential offsite exposure also was estimated at the nearest commercial building to the ERTC industrial park property line. The residential receptors modeled for the Palomar project construction activities were used to assess the potential residential exposure for the cumulative analysis.

The ISCST3 model was used to estimate the average daily diesel exhaust PM_{10} concentrations at the ERTC industrial park property line and residential receptors. Mathematically, the average daily concentration is equal to the annual average concentration. For both the maximum property line and residential receptors, the composite annual concentrations were multiplied by the diesel particulate matter unit risk factor of 300 per million per $\mu g/m^3$ to yield the estimated 70-year cancer risk.

The estimated residential 70-year exposure cancer risk posed by diesel emissions from the ERTC industrial park grading activities at the MEIR is 1.0 per million. At the ERTC industrial park property line, the point of PMI cancer risk is 11 per million. However, at the nearest commercial building, a somewhat more realistic exposure location than the property line itself, the modeled occupational 70-year cancer risk at the MEIW is 4.9 per million. The maximum risk at the MEIR and MEIW are below the ARB and SDAPCD significance level of 10 per million. The estimated cancer risk at the PMI is slightly above the 10 per million level.

It should be noted that these construction emissions and potential exposures are extremely temporary (70 days), while risk estimates are based on assumed exposures of 70 years. The modeled results are thus extremely conservative and can be considered unrealistically high. Further, as discussed in Section 5.15.2.4, there are a variety of other sources of likely overestimation of risk that are inherent in the risk assessment process. For these reasons, a modeled result of slightly over 10 per million does not establish a finding of significant risk for short-term construction-related exposures. The City's ERTC industrial park EIR is expected to address this issue and the possible need for mitigation.

Chronic, non-cancer risks also were estimated. The estimated annual concentration of diesel particulate matter (PM_{10}) due to ERTC industrial park grading activities at a residential receptor is 0.23 μg/m^3. The resulting hazard index, based on a chronic reference exposure level of 5.0 μg/m^3, is 0.05. The estimated annual concentration of diesel particulate PM_{10} at the nearest commercial building to the ERTC project site is 1.1 μg/m^3, resulting in a hazard index of 0.2. At the ERTC industrial park property line, the PMI diesel particulate annual PM_{10} concentration is 2.6 μg/m^3, resulting in a chronic hazard index of 0.5. The maximum chronic hazard index at the MEIR, MEIW, and PMI are all below the CARB and SDAPCD significance level of 1.0. There currently is no accepted acute risk exposure level for diesel particulate. Therefore, no acute index estimate was calculated.

ERTC Operations

Public health impacts of ERTC industrial park operations are expected to be addressed in the City of Escondido EIR. As discussed in Section 5.15.2, the Palomar project will result in insignificant localized public health impacts during project operations. It is expected that the Palomar project's contribution to cumulative public health impacts would be less than considerable.

5.15.6 LORS Compliance

Public health LORS that are applicable or potentially applicable to the Palomar Energy Project are outlined in Section 6.4.2. The project will operate in accordance with the LORS applicable to public health.

5.15.7 Involved Agencies and Agency Contacts

Agencies and agency contacts relevant to public health issues analyzed in this section are provided in Table 5.15-9. Agency and agency contacts for hazardous materials handling are provided in Section 5.12.

Table 5.15-9 Involved Agencies and Agency Contacts

Agency/Address	Contact/Telephone	Permits/Reason for Involvement
San Diego Air Pollution Control District 9150 Chesapeake Drive San Diego, California 92123-1096	Mike Lake (858) 650-4700	Determination of Compliance

5.15.8 Permits Required and Permit Schedule

Agency-required permits related to public health issues analyzed in this section are summarized below in Table 5.15-10. Agencies will be contacted to obtain the necessary permits at the appropriate time. Agency-required permits for hazardous materials handling are provided in Section 5.12.

Table 5.15-10 Permits Required and Permit Schedule

Permit/Approval Required	Schedule
Determination of Compliance	Application submittal concurrent with submission of AFC.

5.15.9 References

California Air Pollution Control Officers Association (CAPCOA). 1993. Air Toxics *"Hot* Spots" Program: *Revised 1992 Risk Assessment Guidelines.*

California Air Resources Board (ARB). 2001. California Air Toxic Emission Factor (CATEF, http://www.arb.ca.gov/emisinv/catef/catef.htm). Updated with AB2588 Phase II toxic emission factors in January 2001.

California ARB. 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. October.

California ARB. 1998. Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant. August.

Federal Register (FR21506). 2000. Requirements for Preparation, Adoption, and Submittal of State Implementation Plans (Guideline on Air Quality Models); Proposed Rule. Vol. 65, No. 78. April 21, 2000.

Office of Environmental Health Hazard Assessment. 2000. Fact Sheet on Health Effects of Diesel Exhaust. August. From website http://www.arb.ca.gov/regact/diesltac.htm.

Office of Environmental Health Hazard Assessment. 2001. Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values. Updated September 13, 2001.